OXC - 1024
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28 October 1960

MEMORANDUM FOR : Chief, Development Branch, DPD-DD/P

SUBJECT : Trip Report - [redacted] 25X1

1. PURPOSE:

A visit was made to Eastman-Kodak to discuss various subjects and attend a meeting between E-K and Perkin-Elmer regarding mutual thermal problems in the "C" program.

2. GENERAL:

A. Red Dot Tests: Mr. Green has informally proposed to conduct a "red dot" test, using the U-2 aircraft, primarily to determine whether low gamma films or products have an advantage in aerial photography. This study would be applicable to all programs, but be slanted primarily toward "C." A formal proposal will be forwarded in the near future with funding requirements and an operational plan attached. Roughly, ten flights would be required at various altitudes and with various films and filters. I told Mr. Green that I concurred with the objectives of these tests, but Headquarters would have to review the cost and the availability of aircraft prior to approval. In summary this test program would:

(1) Investigate low gamma film vs. 2402 in actual flight conditions.

(2) Investigate low gamma processing as a comparison to low gamma taking material.

(3) Study atmospheric attenuation predictability using the aircraft in known conditions as a control for this study.

(4) Study fine grain (243) film in small cameras at slow shutter speeds as an input to problems of small scale aerial photography.

(5) Provide control data for studies of variations in spectral sensitivity.

(6) Estar base would be tested against tri-acetate for mechanical handling under controlled conditions.

(7) Use three each A-2 cameras in a tri-vertical hatch to accomplish the majority of the airborne portion of this test program.

B. P-E Discussion On Thermal Problems In "Q": The basic objective of the P-E approach is to provide an isothermal bay by using aircraft airconditioning to maintain 110 to 120°F for the Q-bay. The camera equipment is enclosed in an inner bag of helium at 1/3 atmospheric pressure. Theoretically, the major problem is to control the heat entering the Q-bay through the two photo windows. They estimate that blowing air across the windows will take away about 2000 BTU's per hour and keep the bay at an acceptable level. The desired maximum heat tolerance for this approach on the inside surface of the windows is 140°F. Tests to date in their small furnace (the new furnace will be in operation in a few weeks) are as follows:

(1) Linear gradients are more acceptable than non-linear. Random variations of over 1/2°F are unacceptable.

(2) Helium performs better than air under these conditions for both optics and thermal convection.

(3) In a rough experiment, with a furnace simulating an outside temperature of 490°F, the inside surface temperature of the window was kept at 138°F with no special coating but using a vacuum in the space between the two windows and blowing cool air over the inside surface. A three window system is being investigated as a back-up.

(4) Since the system is not photogrammetric, the wedge shapes produced by linear heat gradients across the windows accompanied by a constant change in the index of refraction are not expected to be significant.

(5) Test verified analog computations and assumptions use in design very closely. There is a definite lag in heat effects from outer to inner surfaces of windows and the variations of heat on the inner surface are very small for reasonably large changes on the outer surface.

(6) Complete optical measurements have not been made in tests as yet, however, the new furnace will permit this test with windows in proper position and thermal convections controlled.

(7) To date, 60 pieces of 5 inch diameter by 3/16 inch quartz samples have been tested for breakage under pressure. (Thermal tests for breakage had previously been completed satisfactorily). The quarts must stand 5,000 p.s.i. and test indicate an average breakage, for various groups of induced scratches, at between 5,000 and 11,000 p.s.i. Fatigue factors are not completely known and additional tests are planned.

C. EK Discussion On Thermal Problems In "O": The basic objective of the EK approach is to provide an envelope of cool air in a hollow outside shell of the film cassette to maintain 120°F and protect the film which is the item most critically effected by heat. The over-all O-bay would be maintained under ambient conditions of heat and pressure. EK studies on maintaining linear heat gradients agreed with the P-E tests and studies. In order for their system to operate to the desired resolution, the temperature differential must be uniform within the lens system which is outside of the 120°F envelope. They also stated that their primary mirror could only tolerate a maximum of 2°F differential in heat even if it was linear. Studies to date indicate:

(1) An assumed outside temperature of 500°F with one window would give an inside temperature of 415°F and with a double window, 133°F. The difference in the EK and P-E figures for the double window is relatively small and attributed to the fact that EK has only one square window while P-E has two rectangular windows and pressures and coatings were different. Also, the EK window is flat with the underside of the aircraft with a slight faring in and out which LAC said they could tolerate in this configuration, while P-E windows are flush "V" shaped installations.

(2) EK contends that the primary mirror, which is the closest component of the lens system to the window heat source, should not be bothered by heat gradients since they would be along the plane of the mirror rather than through it. They did state that they may need a shield at the bottom of the mirror to keep heat

from the windows away from the back of the mirror.

(3) LAC gave EK a figure of 7,000 BTU per hour capacity for heat removal available from the air conditioning system. EK indicated that their approach might provide satisfactory operation even if one of the two air conditioners on board failed. I informed them that, unless some change had occurred in the operational concept of which I was unaware, the mission would abort immediately if any failure occurred which was related to safety of the pilot. Even though an air conditioner could fail from causes other than engine failure and the aircraft continue to operate properly, the margin of safety was gone.

(4) EK is concerned that the vacuum seal in a double window may cause significant distortion. In this case, pressure causes more distortion than heat effects. Thicker windows may improve the situation, but there is a point of diminishing returns and the true significance of this factor is not known. P-E was not especially concerned over this factor although they are considering it. The reason for difference in degree of concern is probably due to the fact that the P-E system looks through the windows at a maximum angle of 45° while the EK system looks through their window at a maximum of 60°. All concurred that this factor was probably negligible in the vertical and more significant at oblique angles. In either case, the distortion could be either a straight focal shift or astigmatism.

(5) A brief discussion of window thermal coatings revealed that research is still to be completed to give consistant results to tests. EK has one "metallic" coating with an emissivity approaching 75 to 90% in test. This is apparently better than P-E's and EK said they could sell it to them. This was said jokingly, but there was some sidestepping on this subject from both sides. I feel that it was more from a conservative attitude on results to date rather than any unwillingness to state capabilities.

3. COMMENTS:

A. Generally, for the first meeting between two rival companies on a common problem, I thought that cooperation and a free exchange was evident.

B. Basic principles and findings of both companies are in general agreement. The approaches, however, are different and theoretically both possible. In summary:

(1) EK expounds the theory of optical performance through uniformity of temperature and pressure at ambient or high temperatures and low pressures with air conditioning of the film only.

(2) P-E sets forth the theory of optical performance through control of the total camera environment in both temperature and pressure.

C. EK recommended investigation of the possibility of providing for both approaches through establishing a requirement for LAC to go both ways at this date. Obviously, if LAC could make such a provision at no cost in time, funds, or complications, this proviso would be in our best interests in my opinion. It is recommended that this question be raised with LAC.

D. It was apparent that both companies are still working with parameters provided by LAC on a theoretical basis. Any changes to this data as a result of LAC testing or studies should be disseminated as soon as possible to both EK and P-E.

E. I personally feel that the EK system is at least as good an approach as the P-E design. EK has a definite feeling of frustration over the stretch out funding and small amount of effort permissable. In addition, the V/H problem is totally in P-E hands and a satisfactory solution has not been achieved. Also, the interface problem with the vehicle are definitely directed toward the P-E system. There are still many unknowns in both systems. I had the feeling that EK might have believed that they were being brain-picked just before being set out to pasture. If this is true, future meets on a common ground between the companies involved may meet with some resistance. The EK effort needs to be directed along firm ground or redirected to a definite phase out.

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